U.S. Department of Energy
Advanced Research Projects Agency – Energy

Announcement of Teaming Partner List for an upcoming Funding Opportunity Announcement:

Replacement Encapsulation of Pipelines Avoiding Intensive Replacement (REPAIR)

The Advanced Research Projects Agency – Energy (ARPA–E) intends to issue a new Funding Opportunity Announcement (FOA) entitled Replacement Encapsulation of Pipelines Avoiding Intensive Replacement (REPAIR). The purpose of this announcement is to facilitate formation of diverse project teams to respond to REPAIR. ARPA-E invites interested parties to submit their information to the Teaming Partner List.

REPAIR addresses the high costs to replace cast iron, wrought iron, and bare steel natural gas distribution pipes. Gas utilities operate 60,000 miles of these older pipes. Excavating and replacing these pipes costs $1-10 million per mile. REPAIR will reduce costs by creating a new pipe inside the old pipe, using smart coatings to achieve a 50-year life. The FOA will target pipes with 10-inch and larger diameters.

Success requires several technology advances, including new pipe testing methods and models; advanced coatings; tools that can deposit coatings, inspect coatings, and map pipes; and 3-D data visualization and management software. There are two metrics for REPAIR: obtain regulatory approval for REPAIR processes, and rehabilitate pipes for $1 million per mile, including costs for gas service interruptions.

As outlined below, REPAIR has five tasks: one for test development and testing, and four to develop system components – coating materials, coating deposition tools, coating integrity/inspection tools, and pipe mapping tools. Applicants may respond to an individual task or multiple tasks. Applicants will need to address plans for integrating system components in tasks 2-5 into comprehensive solutions. ARPA-E encourages partnering across tasks, and forming teams with diverse skills, such as engineering, chemistry, material science, physics, and data processing/visualization, for all tasks.

Tasks 1 -Testing models/protocols/hardware

In order to confirm the required 50-year lifespan there is a need to define failure modes and establish the performance criteria for “coated pipe in a pipe” with cast iron and bare steel pipes. Modelling will be used to characterize failure modes, establish ranges of physical properties for Task 2 coatings, develop test methods, and design/build test hardware. Applicants will be responsible for testing 10-20 inch diameter coated pipes, and use results to develop correlations for failure mechanisms.

Task 2 - Structural coating materials

Legacy pipes will be rehabilitated by applying a structural coating to the inside of the pipe, forming a “coated pipe in a pipe.” Materials will be coated with a coating deposition tool discussed in Task 3, and inspected with an integrity/inspection tool discussed in Task 4. REPAIR will advance the state of

gas distribution pipelines by incorporating "smart" (i.e. self-healing and self-reporting) features. Coating materials need to be compatible with pipeline operations. ARPA-E prefers materials that can be deposited without interrupting gas service.

Task 3 - Coating deposition tools

There are several techniques for depositing structural coatings, such as spraying, casting, and printing/additive manufacturing. The coating deposition tool will record operating parameters, quality control metrics, and material traceability by location, with location precision within 10 cm over its operating range. As an option, the coating tool could use in-pipe mapping tools discussed in Task 5. Critical issues include linear speed, deposition rate, uniformity of coating thickness, and impact on gas service during coating operations. Task 3 Applicants are encouraged to collaborate with Task 2 Applicants to optimize deposition processes.

Task 4 - Pipe integrity/inspection tools

Integrity/inspection tools are needed to assess the legacy pipes prior to coating, and assess the coating after deposition. Ideally the same techniques and tools can be used for pre- and post-coating inspections, implying the inspection technique can "see" through the coating. Task 4 Applicants are encouraged to collaborate with Task 2 Applicants to screen and select the optimal inspection technique(s). The integrity tool needs to be able to record locations within 10 cm over its operating range. As an option, it could use in-pipe mapping tools discussed in Task 5. ARPA-E anticipates different inspection techniques and tools may be required for cast iron and bare steel pipes.

Task 5 - 3D mapping hardware, data management, and data visualization

Applicants for Task 5 will develop tools that create 3D maps of the rehabilitated gas mains, pipeline components, and adjacent underground infrastructure. Applicants can propose in-pipe or surface-based pipe mapping technologies, or a combination of technologies. These maps will also incorporate data from leak reports, integrity/inspection tools, and coating deposition tools. REPAIR processes (coating, inspections, mapping) will generate large data sets that need to be compatible with GIS-enabled enterprise systems used by gas utilities. Given the large data sets, real-time data visualization will be required to facilitate real-time decisions in the field as mapping, coating, and inspection processes are underway.

The ARPA-E workshop on REPAIR occurred October 2019; details are available at https://arpa-e.energy.gov/?q=events/rapid-encapsulation-pipelines-avoiding-intensive-replacement-workshop. Key stakeholders from technical areas of interest gathered to further define REPAIR's problem statement and explore possible solutions. Based on feedback from the workshop, ARPA-E is hosting an Industry Day on January 22, 2020 in Washington, DC. The event will provide an opportunity to address contracting and technical questions of the RFI (to be released, along with a draft version of the FOA, ahead of the event), and promote formal and informal partnering discussions. ARPA-E recommends Applicants complete the Teaming Partners information prior to the Industry Day.

The Teaming Partner List is being compiled to facilitate the formation of new project teams. ARPA-E intends to make the Teaming Partner List available on ARPA–E eXCHANGE (https://ARPA–E-foa.energy.gov), ARPA–E's online application portal, December 20, 2019. Once posted, the Teaming Partner List will be updated periodically, until the close of the Full Application period, to reflect new Teaming Partners who have provided their information.

Any organization that would like to be included on the Teaming Partner list should complete all required fields in the following link: https://ARPA–E-foa.energy.gov/Applicantprofile.aspx. Required information

includes: Organization Name, Contact Name, Contact Address, Contact Email, Contact Phone, Organization Type, Area of Technical Expertise, and Brief Description of Capabilities.

By submitting a response to this Notice, you consent to the publication of the above-referenced information. **By facilitating this Teaming Partner List, ARPA–E does not endorse or otherwise evaluate the qualifications of the entities that self-identify themselves for placement on the Teaming Partner List.** ARPA–E will not pay for the provision of any information, nor will it compensate any respondents for the development of such information. Responses submitted to other email addresses or by other means will not be considered.

This Notice does not constitute a FOA. No FOA exists at this time. Applicants must refer to the final FOA, expected to be issued in late January 2020, for instructions on submitting an application and for the terms and conditions of funding.